Environmental Study on Measurement of Heavy Metal Concentrations in Tigris River at Taji Beach Area

Wrood K. Abood

[1] Department of Physics, College of Education, Al-Iraqia University, Baghdad, IRAQ

The present investigation was carried out on the water of the Tigris River in the Taji region, north of Baghdad, as part of the Karkh Water Project. The station was selected for a project to purify water and provide the Karkh regions with this resource. The study involved determining the levels of heavy metals in the Tigris River's waters between October 2022 and March 2023. Five heavy metals (Hg, Ni, Cr, Pb, and Cd) were extracted from three river water models. The study's findings revealed elevated levels of lead and cadmium, both of which were beyond the allowable limits of the Iraqi standard. Cadmium concentrations ranged from 0.009 to 0.034 mg/L, which is more than the allowable limits in all phases of drinking water, while lead concentrations varied from 0.005 to 0.15 mg/L, which were excessive in comparison to the permitted limits.

***Keywords*:** Heavy metals; Cadmium pollutant; River waters; Water pollution
Received: 08 October 2024; **Revised:** 10 December 2024; **Accepted:** 17 December 2024

1. Introduction

Pollutant emissions into the environment, particularly those of heavy metals, are a global issue. When their concentrations exceed what is considered safe, the majority of them have harmful impacts on life [1]. Soil erosion, rock weathering, and the dissolving of water-soluble salts are the main sources of heavy metals, which are either biologically or chemically introduced into river water. Numerous human activities are closely linked to the levels of heavy metals in aquatic ecosystems [2,3]. Heavy metals, such as mercury, are considered Lead, arsenic, cadmium, and selenium are among the most dangerous substances that pollute the soil. Water, and the most important sources of this pollution are waste, plant waste, Combustion of coal and automobile exhausts and pesticides containing arsenic [4]. One of the major health problems in drinking water sources is the presence of heavy elements with concentrations exceeding the permissible limits according to international and Iraqi standards for water [5]. Since heavy elements are a potent and effective factor in the suffering of humanity and various diseases, including cancer, and that all these metals share much in their natural qualities Their chemical reactions are different, and this applies to the environmental effects of some of these minerals. As mercury, lead, and cadmium create a risk to public health, minerals other than chromium, iron, and copper are limited in their effects on the workplace that occur. Where exposure to long periods is therefore less dangerous than other metals such as lead Which has increased in recent times and become very abundant in water, air, and food [6]. Even in very small amounts, many heavy metals are necessary for life, but when their concentration in the body rises to a point where it might disrupt cell development and the gastrointestinal system, they become hazardous [7]. There are trace amounts of heavy metals. in the aquatic environment [8]. The water contains heavy elements. occurs naturally and in different amounts depending on the environment due to several factors, such as geological erosion of rocks containing elements because of a number of things, including the geological weathering of rocks that contain elements, the mining of raw materials, the industrial processes for preparing and using metals and their compounds, and waste, chemical factories, agricultural pesticides, and chemical fertilizers [9]. Agricultural pollution, industrial pollution (chemical, engineering, food, textile, and construction sectors), and pollution from civic operations are the main causes of pollution in the Tigris River's heavy elements [10]. The effectiveness of desalination facilities and the quality of the water in Iraq have been the subject of several studies. There are notable variations in the chemical makeup of water, as noted by a water researcher [11]. In the various months of the year, raw and slant water [12].

Investigating the effects of heavy metals in the Tigris River and the Alkarkh water project was the goal of the current study.

2. Experimantal Work

Samples were collected from the Karkh water purification station located north of Baghdad in the Taji Beach area. Samples were taken in three stages. The first stage was that, before treating the water of the Tigris River, samples were taken directly from the river near the Karkh Water Project station. The second stage is fresh, untreated water before entering purification and treatment. In the third stage, treated water enters purification. Concentrations of heavy metals (cadmium, lead, chromium, nickel, and mercury) in the water of the Tigris River were measured over a period of six months by atomic absorption spectrometry.

Water samples were taken from the study sites and 2 liters for each sample were filtered through a type of Millipore Filter Paper 0.45 µm. It was previously washed with nitric acid (0.5N), then with deionized water, and dried at a temperature of 60 °C for 12 hours. 1.5 mL of concentrated nitric acid were added to every 1 liter of filtered water samples for the purpose of preserving the elements in their ionic shape, then take 100 mL of filtered water and evaporate at a temperature of 70 °C before drying. A 1.5 mL of concentrated nitric acid was added to every 1 liter of filtered water samples for the purpose of preserving the elements in their ionic state [13]. The samples were measured using a Perkin Elmer 1800 atomic absorption spectrophotometer, as shown in Fig. (1). This measurement was carried out at the Central Environmental Laboratory, College of Science, the University of Baghdad.

Fig (1) Scheme of UV-visible spectrophotometry carried out on the water samples

3. Results and Discussion

Heavy metal pollutants pose a threat to aquatic environments. These pollutants can enter naturally or through human-caused pollution, and they have a significant impact on a variety of living forms in these settings. Unlike other forms of pollution, heavy metal pollution is invisible [14]. The results of the study showed that the concentrations of cadmium and lead were higher than the Iraqi standards for drinking water and higher than the World Health Organization standards [15,16]. The three water-collecting locations were compared in our study, as shown in table (1) and Fig. (2). At all locations, the results indicated a rise in lead content. For fresh river water, the values ranged from 0.07 to 1.4 mg/L before and after water treatment, respectively. While the percentage of lead in the Iraqi standard specifications for drinking water was limited (0.01 mg/L) [17]. The cause of the lead spike is ascribed to waste from the petrochemical facility, which is close to the purification plant (north of the city), as well as traffic pollution and agricultural wastewater. Heavy metal concentrations increase in tandem with water concentrations. Furthermore, the high temperatures and water shortages during the summer may cause the elements' concentrations to rise, which might lead to excessive amounts of heavy metals in the water.

The findings in table (2) and Fig. (3) indicate that the percentage of cadmium in the water exceeded the natural limits of 0.01, 0.01, and 0.009 mg/L for untreated fresh water, untreated water prior to purification, and treated water, respectively, in contrast to the Iraqi norms of 0.003 mg/L [16]. It is well-known that fertilizers are made with cadmium [18,19]. One of the primary causes of heavy metal pollution in water is the use of fertilizers and pesticides in agricultural areas; these substances can be carried from the environment and result in elevated levels of heavy metals in water [20]. The results of the current study on mercury, nickel, or chromium showed that the concentrations were less than the Iraqi standards for drinking water and less than the World Health Organization standards. Tables (3), (4), and (5) and figures (4), (5), and (6) demonstrate that there were no increases above the Iraqi standards.

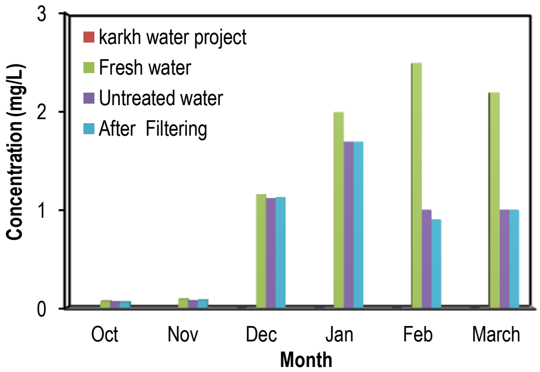

Fig. (2) Monthly changes of lead with concentration

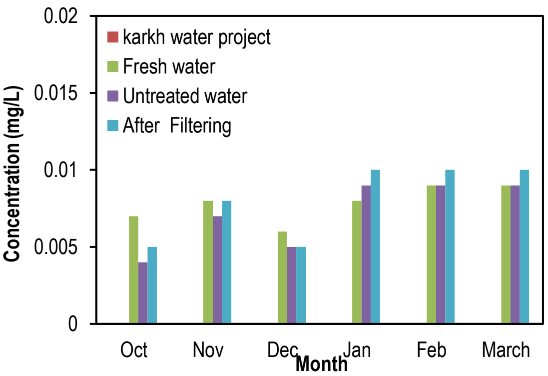

Fig. (3) Monthly changes of cadmium with concentration

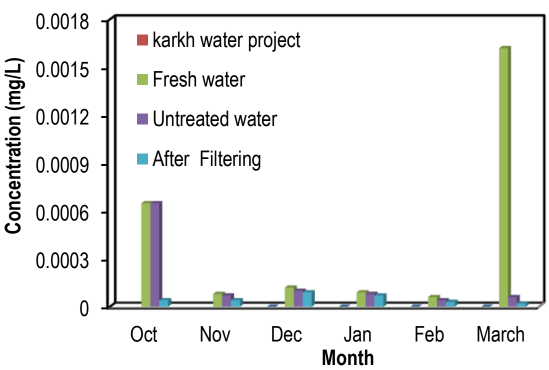

Fig. (4) Monthly changes of mercury with concentration

Vol. 21, No. 1, January-March 2025, pp. 135-138

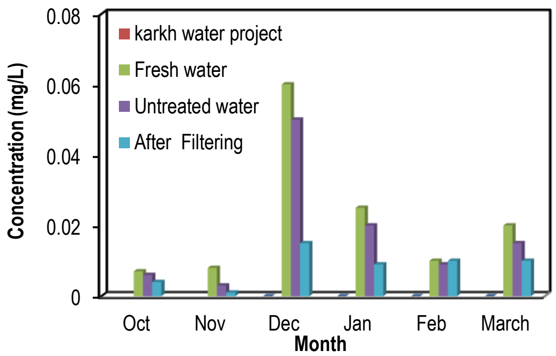

Fig. (5) Monthly changes of chromium with concentration

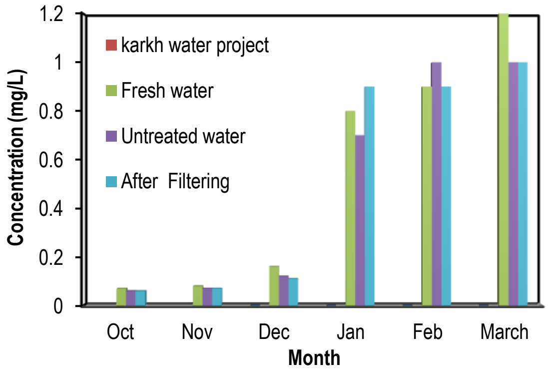

Fig. (6) Monthly changes of nickel with concentration

4. Conclusions

The results of laboratory samples taken from the water of the Tigris River revealed high levels of lead and cadmium that exceeded the limits recommended by the World Health Organization and the Iraqi standard [12,16]. Lead and cadmium, indicators of environmental pollution with heavy metals, have been found to be present in significant concentrations. While the rest of the elements were found to be less than acceptable environmental limits. The presence of this level of pollution gives an indication of the exposure of the Tigris River environment to pollution from wastewater, agriculture, and various organic sources resulting from human activity. This is due to the agricultural character of the area and the use of phosphate fertilizers in agriculture, as well as water pollution from electrical power-generating stations and industrial waste close to the Karkh water filtration station project site.

References

[1] S. Delibacak et al., "Trace element and heavy metals concentration in fruit and vegetables of the Gediz River region", *Int. J. Water*, 2(2/3) (2002) 196-211.

[2] S.M. Saeed and I.M. Shaker, "Assessment of Heavy Metals Pollution in Water and Sediments and their Effect on Oreochromis Niloticus in the Northern Delta Lakes", *Int. Symp. on Tilapia in Aquaculture (Egypt)*, (2008) 475-490.

[3] M.M. Al-Hejuje, N.A. Hussain and H.T. Al-Saad, "Applied Heavy metals pollution index (HPI) as a water pollution indicator of Shatt Al-Arab River, Basrah-Iraq", *Int. J. Marine Sci.*, 7(35) (2017) 353-360.

[4] F.N.M. Al-Hemidawi, A.H. Mohammed and H.T. Al-Saad, "Heavy Metals in water at Al-Delmaj Marsh, Al-Kut Province, Iraq", *Marsh Bulletin*, 15(2) (2020) 127-137.

[5] S.A.R. Al‑Asadi and H.M.A. Al‑Kafari, "Levels and sources of heavy metals pollution in the water and sediments of Al‑Diwaniyah River", *Iraq Sustain. Water Resour. Manag.*, (2022) 101.

[6] A.H. Al-Sulttani, A.A.F. Beg and A.H. Dahash, "Assessment of Heavy Metals Concentration in Water and Fish of Dalmaj Marsh Iraq", *Iraqi J. Sci.*, 63 (2021) 3761-3774.

[7] D.K. Hammood and R.A. Abudl-Jabar, "Concentrations of heavy metals in the Euphrates rivers Eastern of Ramady", *Tikrit J. Pure Sci.*, (2016) 24-29.

[8] A.H. Ghawi, "Hydraulic Rapid Flash Mixing To Predict Turbidity Removal In Water Treatment", *The Iraqi J. Mech. Mater. Eng. (Special vol.), Babylon First Int. Eng. Conf.*, (2016) 57-68.

[9] A.H. Ghawi, "Using Natural Coagulant To Remove Turbidity And Heavy Metal From Surface Water Treatment Plant In Iraq", *Int. J. Eng. Technol. Sci. Innov.*, 2(1) (2017) 551-563.

[10] M.J. Issa and A.Sh. Qanbar, "Assessment of Heavy Metal Contamination in Euphrates River Sediments from Al-Hindiya Barrage to Al-Nasiria City, South Iraq", *Iraqi J. Sci.*, 57 (2016) 184-193.

[11] A.N.H. Al-Zubaidi, "A study of Al-Kut and Al-Karama water treatment plants efficiency to purify the drinking water in Al-Kut city", M.Sc. thesis, University of Baghdad, Iraq (2011).

[12] F.H.G. AL-Amier, "Study the Impact of the wastewater which discharged from Al-Karama and Sharq- Dijla water treatment plants on water quality of Tigris River", M.Sc. thesis, University of Baghdad, Iraq (2014).

[13] American Public Health Association (APHA), "**Standard Methods for the Examination of Water andWaste Water**", 21st ed., USA (2007) 819-821.

[14] S. Amisah et al., "Effects of clam size on heavy metal accumulation in whole soft tissues of Galatea paradoxa (Born, 1778) from the Volta estuary, Ghana", *Int. Fisher. Aquacult.*, 1(2) (2009) 014-021.

[15] Iraqi Drinking Water Quality Standards, Environmental Legislation (Iraqi standards), Iraqi Directorate for Environmental Protection and Improvement, Ministry of Health, Baghdad, Iraq (1986), p. 14.

[16] World health organization (WHO), "**Guidelines for Drinking Water Quality**", 4th ed., Classification (2011) 541-675.

[17] Standard Specification No. (417), Central Organization for Standardizations and Quality Control, The Ministry of Planning and Development Cooperation, Iraq, 2nd update (2009) (in Arabic).

[18] World Health Organization (WHO), "**Guidelines for Drinking Water Quality**", 4th ed., incorporating first addendum (2017), p. 541.

[19] W. Binbin et al., "Sources of heavy metalsin surface sediments and an ecological risk assessment from two adjacent plateau reservoirs", *PLOS One*, 9(7) (2014).

[20] L. Ali and H. Abbas, "Determination of Some Heavy Metals in Tissues of Binni Mesopotamichthys sharpeyi and Water in Al-Dalmaj Marsh/Iraq", *Al-Kufa Univ. J. Biol.*, 15 (2023) 164-177.

Table (1) Monthly and local changes of Lead (Pb) in the studied area

Month / Karkh Water Project	October (mg/L)	November (mg/L)	December (mg/L)	January (mg/L)	February (mg/L)	March (mg/L)	Average (mg/L)	Limits of Iraqi Standard mg/L [16]
River Fresh water	0.07	0.09	1.16	2.0	2.5	2. 2	1.33	0.01
Untreated water	0.06	0.07	1.12	1. 7	1.0	1.0	0.825	0.01
Treated water	0.06	0.08	1.13	1. 7	0. 9	1.0	0.811	0.01

Table (2) Monthly and local changes of Cadmium (Cd) in the studied area

Month / Karkh Water Project	October (mg/L)	November (mg/L)	December (mg/L)	January (mg/L)	February (mg/L)	March (mg/L)	Average (mg/L)	Limits of Iraqi Standard mg/L [16]
Fresh water	0.004	0.008	0.006	0.08	0.0 9	0.01	0.034	0.003
Untreated water	0.004	0.008	0.005	0.07	0. 08	0. 01	0.03	0.003
Treated water	0.003	0.007	0.005	0.07	0.08	0.009	0.029	0.003

Table (3) Monthly and local changes of mercury (Hg) in the studied area

Month / Karkh Water Project	October (mg/L)	November (mg/L)	December (mg/L)	January (mg/L)	February (mg/L)	March (mg/L)	Average (mg/L)	Limits of Iraqi Standard mg/L [16]
Fresh water	0.00065	0.00008	0.00012	0.00009	0.00006	0.00162	0.00043	0.001
Untreated water	0.00065	0.00007	0.0001	0.00008	0.00004	0.00006	0.00016	0.001
Treated water	0.00004	0.00004	0.00009	0.00007	0.00003	0.00002	0.00048	0.001

Table (4) Monthly and local changes of chromium (Cr) in the studied area

Month / Karkh Water Project	October (mg/L)	November (mg/L)	December (mg/L)	January (mg/L)	February (mg/L)	March (mg/L)	Average (mg/L)	Limits of Iraqi Standard mg/L [16]
Fresh water	0.007	0.008	0.06	0.025	0. 015	0.02	0.0225	0.05
Untreated water	0.006	0.003	0.05	0.02	0. 009	0.015	0.0171	0.05
Treated water	0.004	0.001	0.015	0.009	0.01	0.01	0.0065	0.05

Table (5) Monthly and local changes of1 nickel (Ni) in the studied area

Month / Karkh Water Project	October (mg/L)	November (mg/L)	December (mg/L)	January (mg/L)	February (mg/L)	March (mg/L)	Average (mg/L)	Limits of Iraqi Standard mg/L [16]
Fresh water	0.007	0.008	0.006	0.008	0.00 6	0.009	0.022	0.02
Untreated water	0.004	0.007	0.005	0.009	0. 004	0.00 9	0.0078	0.02
Treated water	0.005	0.008	0.005	0.01	0.00 4	0.01	0.007	0.02